

NON-PUBLIC?: N
ACCESSION #: 9209100072
LICENSEE EVENT REPORT (LER)

FACILITY NAME: McGuire Nuclear Station, Unit 2 PAGE: 1 OF 10

DOCKET NUMBER: 05000370

TITLE: A Unit 2 Reactor Trip Occurred As A Result Of An Equipment Failure

EVENT DATE: 08/05/92 LER #: 92-09-0 REPORT DATE: 09/04/92

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: Terry L. Pedersen, Manager, Safety TELEPHONE: (704) 875-4487
Review Group

COMPONENT FAILURE DESCRIPTION:

CAUSE: A SYSTEM: HHF COMPONENT: V MANUFACTURER: VALCOR
REPORTABLE NPRDS: Yes

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On August 5, 1992, at 0323, while Unit 2 was operating in Mode 1 (Power Operation) at 100 percent power, a Reactor Trip occurred due to a Steam Generator (SG) Low-Low water level in SG 2B. The Low-Low level condition was caused when valve 2CF-23, SG 2B Main Feedwater Regulating Valve, moved to its fail-safe (closed) position upon loss of power to a controlling safety solenoid. This event is assigned a cause of Equipment Failure caused by loss of power due to a failed blocking diode which caused a blown fuse in the control circuitry to the solenoid. The Turbine Generator automatically tripped as a result of the Reactor Trip. Operations personnel implemented procedure EP/2/A/5000/01, Reactor Trip or Safety Injection, and stabilized Unit 2 in Mode 3 (Hot Standby). With the exception of several minor valve indication problems, all plant systems functioned properly. Repairs to valve 2CF-23 controlling solenoid valve were completed prior to Unit 2 returning to service.

END OF ABSTRACT

TEXT PAGE 2 OF 10

EVALUATION:

Background

The Main Feedwater (CF) system EIIS:SJ! supplies feedwater at the required temperature, pressure, and flow rate to the Steam Generators (SG) EIIS:SG! to maintain the proper SG water level with respect to Reactor power level and Turbine EIIS:TRB! steam requirements.

The CF system includes a CF regulating valve EIIS:FCV! in the flow path to each of the four SGs. The individual CF regulating valves are 2CF-17, 20, 23, and 32 for SGs 2D, 2C, 2B, and 2A, respectively. The CF regulating valves are pneumatically operated and are designed to fail closed upon loss of electrical power or loss of control air. If a CF regulating valve fails closed at full power, the water level in the affected SG will begin to rapidly decrease. If two of the four narrow range level indicators EIIS:LI! for the affected SG reach the SG Low-Low Level Reactor Trip setpoint of less than 40 percent level for 100 percent Rated Thermal Power (RTP), an automatic Reactor Trip will be initiated. The SG Low-Low Level signal will also cause the Auxiliary Feedwater (CA) system (EIIS:BA) to automatically start and supply flow to the SGs.

Each CF regulating valve has two solenoid valves EIIS:PSV! in series in the control air supply line. Each solenoid valve is provided with a Separate (Train A and Train B) DC power supply EIIS:JX!. The positive and negative leg of each solenoid valve power supply includes a fuse EIIS:FU! to protect the solenoid against electrical faults. On a loss of power to either solenoid, the solenoid valve will isolate and vent the controller EIIS:FU! air supply, and the associated CF regulating valve will fail closed. The fuses for the positive and negative legs for valve 2CF-23, SG 2B CF Regulating Valve, are located in separate enclosures.

The CF regulating valves can be operated automatically from the control signal or manually by a controller on the Main Control Board EIIS:MCBD!

Description of Event

On August 5, 1992, at 0322:13, with Unit 2 operating in Mode 1 (Power Operation) at 100 percent power, Operations (OPS) Control Room (CR) personnel received an annunciator EIIS:ANN) alarm EIIS:ALM! for "Valve 2CF-23 SG 2B Feed Regulator Valve Greater Than 75 Percent Closed". This

alarm was followed by "SG 2B Flow Mismatch Low CF Flow" and "SG 2B

TEXT PAGE 3 OF 10

Level Deviation" alarms. At 0323:09, Unit 2 tripped due to a SG 2B Low Level Reactor EIIS:RCT! Trip, which caused the Turbine to trip.

OPS CR personnel entered procedure EP/2/A/5000/01, Reactor Trip Or Safety Injection, to stabilize the unit. With 2 out of 4 channels EIIS:CHA! in SG 2B indicating a SG Low-Low water level condition, both motor EIIS:MO! driven CA pumps EIIS:P! started at approximately 0323.

The following equipment malfunctions were noted during, or immediately after the trip:

- 1) Valve 2CF-23 failed closed. At 0323, an investigation was initiated as directed by work order (w/o) 92059247 to determine why valve 2CF-23 failed closed.
- 2) Valve 2CF-20, SG 2C CF Regulating valve, closed properly, however, the position indication in the CR failed to indicate the valve was closed. Valve 2CF-20 position indication was subsequently repaired as directed by w/o 92059277.
- 3) Valve 2CF-106, SG 2C CF Inlet Bypass Control, closed properly, however, the position indication in the CR indicated the valve was in an intermediate position. Valve 2CF-106 was subsequently repaired as directed by w/o 92059286.
- 4) Valve 2BB-6, Engineered Safety Feature SG 2B Blowdown Containment Inside isolation EIIS:ISV!, closed as required on the CA system auto start, however, the position indication in the CR failed to indicate the valve was closed. Valve 2BB-6 was subsequently repaired as directed by w/o 92059262.
- 5) Operator Aid Computer (OAC) EIIS:CPU! indication D0562, CA Pump B, did not respond by changing states, when CA Pump B started at 0323. w/o 92063560 was written to investigate and repair OAC Computer indication D0562. On August 24, 1992, CA pump B was started and computer indication D0562 changed states, as required. Therefore, a decision was made by Planning personnel to void w/o 92063560.

All other plant systems responded properly to the transient. The plant was stabilized within 30 minutes of the Reactor Trip. The required hour notification was made to the NRC at 0401, in accordance with procedure RP/0/A/5700/10, NRC Immediate Notification Requirements.

An investigation of the closure of valve 2CF-23 was conducted by Instrument and Electrical (IAE) personnel. This investigation revealed that valve 2CF-23 failed closed due to a loss of power to solenoid valve 2CFSV0230, Air Supply Train A Safety Solenoid for valve 2CF-23, which isolated and vented off the controller air supply.

TEXT PAGE 4 OF 10

At 0800, a meeting was held with Management, Engineering, IAE, OPS, and Safety Assurance personnel present to coordinate investigation and recovery activities associated with the trip. At the time, it was considered that the fuse could have blown due to circuit conditions or failed mechanically. Simultaneous recovery efforts were initiated to correct either possible failure mode of the fuse.

By 1400, the fuse failure associated with solenoid valve 2CFSV0230 was determined to be an electrical failure due to a fault associated with the solenoid valve itself. During troubleshooting activities, the fuse was replaced twice, and failed each time. The circuit was verified not to contain any unexpected ground paths and the fuse application was verified correct. It was determined that the solenoid valve failure was due to a failed blocking diode in the rectifier EIIS:RECT! assembly. Solenoid valve 2CFSV0230 and the associated FNQ 2 fuse was subsequently replaced. An action plan was developed to remove rectifier assembly blocking diodes in all Unit 1 and 2 CF regulator solenoid valves.

On August 9, 1992, at 0400, Unit 2 was returned to Mode 1.

Conclusion

This event is assigned a cause of Equipment Failure. A failed Blocking Diode in the Train A safety solenoid for valve 2CF-23 caused a Bussman FNQ 2 fuse to blow in the positive leg of the control circuit of solenoid valve 2CFSV0230. Failure of the fuse caused the Train A safety solenoid valve 2CFSV0230, to lose power, isolating and venting the controller air supply to valve 2CF-23. Upon loss of the controller air supply to its pneumatic actuator, valve 2CF-23 failed to its safety position (closed) as designed, which reduced CF flow to SB 2B. When SG 2B reached a low-low level condition, the Reactor and Turbine Generator EIIS:GEN! automatically tripped. Following the Unit 2 Reactor Trip, IAE personnel investigated the closure of 2CF-23 to identify the cause for the blown fuse. Further investigation was performed which included:

- 1) A careful examination of the control circuitry and components exterior to the valve was performed. No evidence of any

grounds or other problems that could have caused the fuse to blow were identified.

2) The normal amperage in the control circuit was calculated by Engineering personnel as less than 0.5 amps.

3) Solenoid valve 2CFSV0230 was examined by IAE and MES personnel, and it was determined that a blocking diode within the rectifier circuit for the valve

TEXT PAGE 5 OF 10

solenoid coil EIIS:CL! had failed, thus causing a current level above the rated level of the FNQ 2 fuse in the control circuitry. When the current level exceeded 2 Amps, the fuse blew as required.

A search of Nuclear Plant Reliability Data System (NPRDS) data related to diode failures in solenoid valves was conducted. The manufacturer was contacted regarding the diode failure. There was insufficient data provided to form any conclusion related to this equipment failure. No other such diode failures have been identified at McGuire Nuclear Station (MNS). This failure appears to be of an isolated nature. The failed diode and several identical good diodes were sent to the Duke Power Applied Science Center for additional analysis. This analysis did not reveal any additional information regarding the cause of diode failure.

Solenoid valve 2CFSV0320 was replaced prior to Unit 2 returning to service. Due to previous problems with CF regulating valves, actions that were initiated as a result of the trip included implementation of a modification to remove the blocking diode in the rectifier circuit for all Unit 2 CF regulator solenoid valves, and a similar modification for Unit 1 CF regulator valves is planned for the next refueling outage.

Also, a Nuclear Station Modification (NSM) has been implemented (on all valves on Unit 2 and 3 of 4 valves on Unit 1) to add parallel path solenoid valves to all CF regulator valves. This modification will prevent a single solenoid valve failure from inadvertently closing a CF regulator valve.

Prior to the previous refueling outages on Units 1 and 2, the CF regulator valves were Valcor model number V70900-21-3. This type of valve is designed to be used in applications providing DC control voltage only and does not contain a rectifier assembly. During the last refueling outages, these valves were changed to Valcor model number V70900-65 type because the model number V70900-21-3 valves had a history

of sticking open. The type V70900-65 valve is specified as a direct replacement for type V70900-21-3 valves and may be used on DC or AC control voltage EHS:EC! applications. The rectifier assembly in a type V70900-65 is not needed for conversion of AC power to DC power in this application because all CF regulator valves at McGuire Nuclear Station are provided with DC control power. The rectifier circuit does, however, protect the solenoid assembly from power line transient surges. Prior to this event, these components were wired into the circuit because they are inside the valve assembly, and because these components were not considered a significant contributor to a potential valve failure.

During trip recovery activities, a routine inspection inside Unit 2 Containment building was performed. One purpose for this inspection was to determine the source of unidentified leakage less than 1 GPM that was initially detected on July 28, 1992. The inspection revealed 2 leaking welds on the Chemical and Volume Control (NV) System EHS:CB! piping, near the letdown orifices EHS:OR! and is documented on Problem Investigation Report (PIR) 2-M92-0126. The 2 cracked welds on the NV system piping were repaired in accordance with

TEXT PAGE 6 OF 10

approved procedures by August 8, 1992. Twelve other welds in the immediate vicinity of the flawed welds, judged to be subjected to similar loadings, were inspected for cracks and no reportable indications were found. A section of piping containing one of the flawed welds was removed from the system for metallurgical examination. The metallurgical exam confirmed that the crack was a result of fatigue and is suspected to be the result of vibration due to flashing and cavitation of water through the letdown orifice. Appropriate evaluations were performed and the affected section of NV piping was determined past inoperable from July 28, 1992, until approximately August 8, 1992. The letdown function was maintained, however, additional monitoring will be performed to establish a long term solution to the cracked welds.

A review of the Operating Experience Program (OEP) Database for the 24 months prior to this event revealed 2 Reactor Trips involving the CF system in which the cause was an Equipment Failure. These events were documented in Licensee Event Reports (LERs) 370/92-04, and 370/92-07. LER 370/92-04 involved a valve positioner linkage failure on valve 2CF-20 which affected CF flow to SG 2C. LER 370/92-07 involved a mechanical fuse failure in the control power to a controlling safety solenoid valve for valve 2CF-32, SG 2A CF Regulating valve. Therefore, this event is considered to be recurring. Neither of these events resulted from failure of a diode in the solenoid control rectifier circuit, however, a corrective action for LER 370/92-07 to form a CF Regulating Valve

Reliability Team to study and suggest improvements for CF regulating valves was planned but not yet fully implemented.

This event is NPRDS reportable because of the failed blocking diode within solenoid valve 2CFSV0230.

There were no radiation overexposures, personnel injuries, or radiological releases to the environment as a result of this event.

CORRECTIVE ACTIONS:

Immediate: OPS Control Room personnel implemented procedure EP/2/A/5000/01, Reactor Trip Or Safety Injection.

Subsequent: 1) IAE personnel investigated the cause of valve 2CF-23 having failed closed per work order 92059247. The results of the testing concluded that valve 2CF-23 failed closed due to a failed blocking diode in the rectifier circuit which resulted in an overload current that caused a FNQ 2 fuse in the control circuit for its Train A safety solenoid valve, 2CFSV0230, to blow.

TEXT PAGE 7 OF 10

2) FNQ fuses that were part of a batch that contained previously identified fuses that had failed mechanically were replaced in all Unit 2 CF regulator solenoid valve control circuits.

3) Solenoid valve 2CFSV0230 was replaced.

4) The control power rectifier circuits for all Unit 2 CF regulator solenoid valves were removed as directed by minor modification MG MM-5150.

5) OPS personnel performed a visual inspection of the Unit 2 Containment Building to determine the source of previously identified increased sump levels.

6) Repairs to valves 2CF-20 and 2CF-106 were completed as directed by work orders 92059277 and 92059286, respectively.

7) The limit switch for valve 2BB-6 was verified operating correctly as directed by work order 92059262.

- 8) A portion of the piping containing cracked welds from the NV system letdown orifice piping was removed from the system and a destructive examination was performed.
- 9) A dye penetrant examination of 12 selected welds in the NV system letdown orifice piping was performed. No additional cracks were found.
- 10) The NV system letdown orifice piping containing the cracked welds was repaired.
- 11) A temporary monitoring system EIIS:MON! was installed to monitor vibration and thermal parameters on the Unit 2 NV system letdown orifice piping.
- 12) The failed diode which was removed from solenoid valve 2CF-23 was analyzed by Duke Power Applied Science Center personnel. The results of the examination did not reveal any additional information relating to the cause of the diode failure.
- 13) NSM MG-22410 to add parallel path solenoid valves to all Unit 2 CF regulating valves was implemented.

TEXT PAGE 8 OF 10

- 14) NSM MG-12410 to add parallel path solenoid valves to all Unit 1 CF regulating valves was completed on 3 of 4 CF valves.
 - 15) An operability evaluation was performed for the repaired NV letdown piping. The affected piping was determined to be operable for continued operation through the current fuel cycle.
- Planned: 1) NSM MG-12410 to add parallel path solenoid valves to the remaining Unit 1 CF regulating valve will be implemented.
- 2) The rectifier circuits for all Unit 1 CF regulator solenoid valves will be removed from the circuit as directed by variation notice MCVN-3481.
 - 3) The vibration and temperature data collected for the Unit 2 NV system letdown orifice piping will be evaluated and a long term solution determined, providing continuing assurance of the structural integrity of the letdown

office piping. If a design change is determined to be appropriate, a NSM will be implemented for units 1 and 2.

4) An evaluation will be conducted, as specified by Station Problem Report 4904, to determine a course of action on other DC applications of these solenoids.

SAFETY ANALYSIS:

The Unit 2 Reactor automatically tripped on SG 2B Low-Low water level. The Turbine Generator EIIS:GEN! Trip was automatic as a result of the Reactor Trip. The Reactor Trip as a result of Low-Low SG water level is bound by the "Loss of Normal Feedwater Flow" event of the McGuire Final Safety Analysis Report (FSAR), Chapter 15, Section 15.2.7. The event described in the FSAR is more limiting because it assumes a complete loss of Main Feedwater. The CA system is designed to provide decay heat removal capability following an automatic Reactor Trip from Low Low SG water level.

The CF system was available after the Reactor Trip and continued to provide feedwater flow. The CA system started automatically as designed and provided additional feedwater flow, as necessary, to all 4 SGs to assist in returning SG water level to normal. All primary and secondary system parameters (except for SG B level) necessary to ensure a safe shutdown were at or approaching no-load conditions approximately 30 minutes after the Reactor Trip. Water level in SG 2B reached a low point of 28.3 percent (wide range level indication) and began to recover almost immediately following the Reactor Trip using flow from the CA system. The Reactor Coolant (NC) system EIIS:AB! Power Operated Relief Valves (PORVs) EIIS:RV! and Code

TEXT PAGE 9 OF 10

Safety Valves did not open and were not challenged. The SG PORVs and Code Safety Valves did not open and were not challenged.

This Reactor Trip presented no hazard to the integrity of the NC or Main Steam system EIIS:SB!. There were no radiological consequences as a result of this event.

Therefore, the health and safety of the public were not affected by this event.

ADDITIONAL INFORMATION

Sequence Of Events

PTR - Post Trip Report
SSL - Unit 2 Shift Supervisor's Logbook
PR - Personnel Recollection
OAC - Operator Aid Computer

Date Time Event

8/05/92 03:22:13 Annunciator "Valve 2CF-23 B SG Feed Regulator Valve Greater Than 75 Percent Closed". (OAC,PTR)

03:23:09 SG B Low-Low water level Reactor Trip, Turbine Trip.
(OAC,PTR)

03:23:15 Manual Reactor Trip Initiated. (OAC,PTR)

03:23 Work requests were generated to investigate the cause of valve 2CF-23 failure. (SSL)

04:01 Four hour NRC notification made per procedure RP/O/A/5700/10. (SSL)

05:00 OPS CR personnel secured from procedure EP/2/A/5000/01 and implemented procedure OP/2/A/6100/05, Unit Fast Recovery. (SSL)

05:35 While establishing SG blowdown, OPs CR personnel determined a limit switch on valve 2BB-6 did not work properly. (SSL)

05:55 IAE personnel investigating valve 2CF-23 discovered the failure was due to a blown fuse on Train A circuitry. (SSL)

07:15 OPS CR personnel discovered position indication problems on valves

TEXT PAGE 10 OF 10

2CF-106 and 2CF:-20 (PR)

07:30 Unit 2 returned to Mode 3 (Hot Standby). (SSL)

08:00 A meeting was held with Management, Engineering, IAE, OPS, and Safety Assurance personnel present to coordinate investigation and recovery activities

associated with the trip. (PR)

09:30 OPS personnel entered Unit 2 Containment Building to perform a visual inspection. (PR)

09:30 OPS personnel discovered small leaks on NV system letdown piping inside the Unit 2 Containment Building. (PR)

08/5/92 - 8/8/92 NV system letdown piping weld repaired, solenoid valve 2CFSV0230 and blown fuse replaced, valves 2CF-20 and 2CF-106 repaired, position indication for valve 2BB-6 verified operating properly. (PR)

8/9/92 0400 Unit 2 entered Mode 1. (SSL)

ATTACHMENT 1 TO 9209100072 PAGE 1 OF 1

Duke Power Company T.C. McMEEKIN
McGuire Nuclear Generation Department Vice President
12700 Hagers Ferry Road (MG01A) (704) 875-4809
Huntersville, NC 28078-8985 (704) 875-4809

DUKE POWER

September 4, 1992

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: McGuire Nuclear Station Unit 2
Docket No. 50-370
Licensee Event Report 370/92-09

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a) (1) and (d), attached is Licensee Event Report 370/92-09 concerning a Unit 2 Reactor Trip caused by an Equipment Failure. This report is being submitted in accordance with 10CFR50.73(a)(2)(iv). This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

T.C. McMeekin

TLP/bcb

Attachment

xc: Mr. S.D. Ebnetter INPO Records Center
Administrator, Region II Suite 1500
U.S. Nuclear Regulatory Commission 1100 Circle 75 Parkway
101 Marietta St., NW, Suite 2900 Atlanta, GA 30339
Atlanta, GA 30323

Mr. Tim Reed Mr. P.K. Van Doorn
U.S. Nuclear Regulatory Commission NRC Resident Inspector
Office of Nuclear Reactor Regulation McGuire Nuclear Station
Washington, D.C. 20555

*** END OF DOCUMENT ***
